

认知科学推动的建成环境：从审美判断到智慧管控

Built Environment Supported by Cognitive Sciences: From Aesthetic Judgment to Intelligent Management

陈箐*

同济大学建筑与城市规划学院景观学系副教授

*通讯作者

地址：上海杨浦区四平路1239号

邮编：200092

邮箱：zhengchen@tongji.edu.cn

CHEN Zheng

Associate Professor of Department of Landscape Studies at the College of Architecture and Urban Planning, Tongji University

摘要

随着认知科学与其他相关领域的融合，学者们重新对环境美感体验展开思考。与外显的逻辑判断相对存在的审美判断，是内隐的、基于本能或经验的人脑对信息的直觉加工。因而美感体验也就是人脑对环境信息快速加工的过程，可以帮助人们对外部环境信息进行认知，从而快速做出最有利于自身生存的选择。虽然人类对自然具有天然的喜爱，但人们对自然景观的感受更为复杂。多种貌似纷杂的环境感知可被简化并监测，而这也给了研究者和设计师带来了新思路。与此同时，多个学科的相互融合促进了人工智能等技术的发展，也为人类感官的延伸提供了新的可能。希望藉由本期在认知科学领域下的理论研究和实践探索，推动对环境感知的研究，并通过科学的理解及与技术的结合，建造更加智慧、能主动响应使用者需求的建成环境。

关键词

认知科学；审美；审美判断；环境感知；建成环境；多学科研究

ABSTRACT

The knowledge integration of Cognitive Sciences and other related fields supports the rethinking of environmental aesthetic experience. Compared with the explicit logical reasoning, aesthetic judgment is an implicit way for the brain to process information based on personal instincts or experiences. As a rapid information processing of the environment, the experiencing of beauty facilitates individuals' cognition of environmental information and their prompt making of beneficial behaviors for survival. Compared with human's instinctive love to the nature (or biophilia), our attitude and preference towards natural landscapes is more complicated. Seemingly complex environmental perceptions can be simplified and measured promoting corresponding research and designs. Meanwhile, the multidisciplinary integration provides insights for technologies including Artificial Intelligence and helps people obtain external information through different input channels. In this issue, *LA Frontiers* attempts to encourage researchers to explore a more profound understanding of environmental perception. The combination of scientific knowledge and technology can contribute to the creation of intelligent built environment that can actively respond to people's needs.

KEYWORDS

Cognitive Sciences; Aesthetics; Aesthetic Judgment; Environmental Perception; Built Environment; Multidisciplinary Study

翻译 | 张晨希、田乐、嵇扬

TRANSLATED BY | ZHANG Chenxi, Tina TIAN, Victor Ji

改造并创造美的自然、半自然和建成环境是景观设计学的核心任务之一，环境美感体验也是这个学科乃至整个行业最重要的考量之一^{[1]-[4]}。过去三十年间，认知科学及其他相关领域——如脑科学（Brain Science）、决策科学（Decision Science）和人工智能等——知识的融合，为学者们提供了重新思考环境美感体验的机会。

美（sense of beauty），或者说审美（aesthetics），是一种基于本能或经验的、对外部信息的情感反应，而美学是对这种反应的本质探索及抽象规律总结^[5]。审美判断相对于逻辑判断而存在，通常以情感的形式表达，是人类大脑加工信息的另一种方式^[5]。和逻辑推理这种外显加工不一样，美的感受是内隐的——人们常常难以准确解释或描述自己为什么觉得美或哪里美，又或者他们对自己审美感受的描述或解释是错误的。鉴于美的这一特征，很多美学或相关领域的研究者会绕过审美感受主体的生物学机制和认知过程（信息加工），转而关注审美客体；通过其他的解释体系，去总结在不同文化群体或历史阶段下的审美判断所共同具有的抽象特征，并尝试进一步归纳出超越群体或时空的普适性规律。

通过认知科学等多领域的知识融合，我觉得最有趣的是对人脑的直觉加工（intuitive processing）的理解。多个交叉学科重新定义了美感，认为这是人脑在信息加工过程中进行快速判断的一种特殊方式。在《思考，快与慢》中^[6]，2002年经济学诺奖得主的丹尼尔·卡内曼指出，人脑有两种信息加工的方式：快脑（系统一，情绪脑）加工和慢脑（系统二，逻辑脑）加工。这两种方式都用于处理环境信息——前者较为粗略而快速，后者较为精细，可以反复推敲——以支持人们做出对自己生存更有利的判断。对于前者，我们可以近似地将其视作人脑的“自动驾驶”状态：这是一种基于神经网络的统计学习，可以低耗、快速地处理环境信息^{[6][7]}。有趣的是，现代认知科学对这两种信息加工本质的理解和伊曼努尔·康德的哲学体系是一致的，康德也把审美等直觉感受作为和逻辑相对存在的一种判断^[8]。

认知科学把美感体验视为对环境信息的快速加工过程，提供了一种将环境感知从美学理论拓展出来的思路。基于此，环境心理学延伸出一个研究分支——生态审美学（Ecological Aesthetics）。^[9]人类对于自然有种天然的亲近和喜爱之感，接触自然可帮助我们放松并调节情绪。城市自然的这种疗愈作用可以帮助景观设计师创造更好的户外绿色空间，这些空间对城市居民的身心健康非常重要。本期中，江湘蓉等人分享了中国深圳市国际山公园街区公共开放空间的设计实践和思考，设计团队结合疗愈环境和社会资本友好型社区的相关空间特征提出设计策略，以提升公众在社区公共开放空间中所获得的场所体验，促进公共健康。相比起上述简单的热爱自然或“亲自然天性”（biophilia），人类对

于自然景观的感受更复杂，且其景观偏好还暗含了对于该自然环境是否安全、是否有人照料的判断^{[10][11]}。李佳阳等人评述了“关怀线索”的概念及相关设计实践，期望从小尺度景观元素着手，通过更新人们的既有认知，引导大众重视并认可那些生态健康的景观。现代景观设计中包含多样的利用关怀线索进行的细节处理，如采用金属或玻璃等现代材料的铺装收边以突出自然化种植，或在靠近铺装的种植区中修剪出一个十公分宽的矮草坪条。

Mapping——一项受到了直觉加工启发的设计工具——提供了用以表现场地解构与演化过程的一种组织并关联多样、丰富的信息的手段。刘京一等人结合案例讨论了Mapping的作用、逻辑及其启发设计的机制。陈崢能也从历史、认识论、方法及相关文学渊源4个层面深刻剖析了瓦莱里奥·莫拉比托的新作《想象之城》，进行了可感知存在与虚构景观之间的本质对话，并讨论了“会说话的绘画”作为一种更广泛意义上的语言图像的创造。Mapping及可以被多样化解读的图像和文字，共同帮助设计师梳理并挖掘复杂的场地信息，甚至包括场地认知等晦涩信息。

认知科学的发展促使人们对如何测量美感体验产生新的理解。从进化角度看，审美或外部刺激诱发的正向情绪可能是一种和人类生存相关的直觉经验总结^[11]。它帮助我们对环境信息进行认知，快速做出直觉判断并决定相应的行为倾向，使人类可以在危险或残酷竞争的环境中争取到更大的生存机会或资源。多种貌似纷杂的环境感知其实都可以从情绪效价（affective valence）和情绪唤醒（affective arousal）两个维度简化，而这种维度可以进一步被生理情绪指标所测量^{[12][13]}。这两个维度和相关生理指标提供了一种可以把隐晦的情绪感受和神经生物（Neural Science）、认知加工、健康影响联系起来的方法。本期中，付而康等人在卷积神经网络算法模型的基础上，训练生成可判别人脸情绪的深度学习算法模型，为引入该技术方法辅助智慧城市下的景观设计实践提供了实证支持；王晓博等人采用知觉恢复力量表、恢复结果量表和工作记忆测评应用，探究了不同视觉感知自然度水景的主观恢复力及其对工作记忆的影响。

认知科学的信息加工——尤其是多层次的神经网络结构^[14]——为人工智能提供了一种数据挖掘的途径，同时也给城市信息管理和城市智慧系统设计带来了新思路。神经科学家大卫·伊格曼认为，大脑的本质是一个在黑匣子里的高速处理器，唯一的外部信息来源就是电化学神经信号^[15]。利用大脑的可塑性，人们可以训练大脑对复杂信息的处理能力，重新建立新的网络通道，这或许可以帮助感官受损的人通过其他渠道获取外界信息。例如，通过将声音信号转换为多点振动信号，制作触觉背心，失聪的人穿上此类触觉背心并经过一段时间的学习，可逐渐训练自己的大脑理解触觉信号并“听到”对应的单词^[15]。同理，我们可以利用城市中的传感器或者信号采集装置收集信息，对其进行加工，结合物联网的自动控制技术形成新的智慧管控系统。马丁娜·马扎雷洛等人提出了混合型数字化集成城市系统的概念，将数字技术和实体设施融入到城市环境中，为市民营造新的城市体验。施佳颖等人利用谷歌云视觉API和多层次聚类法，研发出一种半自动化的分类器来识别均质化景观照片，这亦是一种对已有数据信息的挖掘与再利用。

认知科学的发展，让我们可以对环境感知的理解更接近科学本质。这种科学理解和技术的结合，可以创造出更加智慧的、能主动响应使用者需求的建成环境。**LAF**

One of the core missions of Landscape Architecture is transforming and creating beautiful natural and built environment, while environmental aesthetic experience is a substantial topic to this discipline and the profession^{[11]-[14]}. The past three decades witnessed the knowledge integration of Cognitive Sciences and other related fields including Brain Science, Decision Science, and Artificial Intelligence, which supports the rethinking of environmental aesthetic experience.

The sense of beauty or aesthetics is an emotional reaction to external information based on personal instincts or experiences, while Aesthetics both explores the essence and summarizes the abstract rules of such reactions^[15]. Compared with the explicit logical reasoning, aesthetic judgment is another way for the brain to process information through an emotional and implicit expression^[15]. Thus, people often cannot exactly explain why they have a sense of beauty—their descriptions about beauty are incorrect sometimes. Therefore, many studies in Aesthetics and allied fields usually focus and aesthetic objects rather than the biological mechanisms and cognitive processes (i.e. information processing) of individuals who have

aesthetic feelings. Scholars have concluded common abstract characteristics of aesthetic judgment in different cultures or historical periods, and even further summarized the universal rules beyond boundaries of groups or space–time.

In the multidisciplinary integration including Cognitive Sciences, the understanding of intuitive processing of the brain fascinates me the most. The sense of beauty, redefined by a number of inter-disciplines, is a special outcome when the brain makes quick judgments during information processing. Daniel Kahneman, the 2002 Nobel Laureate in Economics, stated in his book *Thinking, Fast and Slow* that human brains have two ways of information processing—fast brain (system one, emotional brain) processing, and slow brain (system two, logical brain) processing^[6]. The processing of the former is immediate yet rough, while the latter is more precise. Two brains can both respond to environmental information upon survival needs. Like the automatic driving mode to a car, the fast brain functions as a sort of statistical learning based on neural networks and can quickly process environmental information with low consumption^{[6][7]}. It is interesting that in modern cognitive sciences, the understanding of the essence of both information processing ways coincides with Immanuel Kant’s philosophy who regarded intuitive feelings (including aesthetics) as the parallel to logic^[8].

As a rapid information processing of the environment from the prospective of Cognitive Sciences, the experiencing of beauty provides an idea of environmental perception rooted in Aesthetics. The Environmental Psychology has also developed a specific research field—Ecological Aesthetics.^[9] Human beings have a natural sense of intimacy and love to the nature, as it can help individuals relax and regulate emotions. With such healing functions, urban green spaces are significant for residents’ physical and mental health. In this issue, Jiang Xiangrong et al. shared their design practice and thoughts on the case of Parkhill Commons in Shenzhen, China. By creating healing environments and improving the spatial characteristics of the friendly community that increase social capitals, the project’s design strategies enhance residents’ daily uses and promote public health. Compared with human’s instinctive love to the nature (or biophilia), our attitude and preference towards natural landscapes is more complicated, involving considerations on safety and maintenance of such landscapes^{[10][11]}. Li Jiayang et al. discussed the exemplary concept “cues to care” with several landscape designs—by intentionally intervening with fine-scale landscape elements, these designs attempt to redirect people’s attention to help them value and sustain landscapes that embody ecological health. Most detailed measures in modern landscape designs can function as cues. For instance, using metal or glass in paving to accentuate the contrast to natural planting, or designing a 10-centimeter-wide lawn strip inbetween the planting area and the paving.

Inspired by intuitive processing, mapping, as a design tool, provides a means of collecting and connecting various information to reflect the site’s structures and evolutionary processes. Liu Jingyi et al. explored mapping’s function, logic, and mechanism through case studies. Albert Zhengneng Chen also deeply analyzed the Valerio Morabito’s new work *The City of Imagination* from perspectives of history, epistemology, method, and reception regarding its literary root, opened the essential dialogues between the palpable existence and fictive landscape, with a discussion about “verbal drawing” as a broader sense of creating verbal images. Mapping and “verbal drawings” with multiple interpretations can help designers sort out, discover, and recognize complex or even obscure information of the site.

The development of Cognitive Sciences generates new understandings of how to measure aesthetic experience. From an evolutionary perspective, positive affective responses induced by aesthetics or external information may stem from human’s intuitive experiences for survival^[11]. Such responses facilitate individuals’ cognition of environmental information and their prompt making of intuitive judgments and beneficial behaviors, helping achieve greater living opportunities and resources in dangerous and cruel competitions. Seemingly complex environmental perceptions can be simplified into two dimensions— affective valence and

affective arousal—which can be measured by physiological affective indicators^{[12][13]}. These two dimensions and related measurement indicators can interpret people’s obscure feelings with knowledge of Neural Science, cognitive processing, and health effects. In this issue, Fu Erkang et al. trained a deep learning algorithm that can discriminate facial emotions based on the Convolutional Neural Network algorithm model, offering empirical references to landscape design practices in the building of smart cities. Wang Xiaobo et al. adopted the Perceived Restorative Scale, the Restoration Outcome Scale, and applications for testing one’s working memory and explored the subjective restoration of waterscapes of varied visual perception of naturalness, and their impact on individuals’ working memory.

In Cognitive Sciences, the information processing—especially with the multilayer neural networks^[14]—provides insights both for the data mining of Artificial Intelligence, and urban information management and urban intelligent system design. Neuroscientist David Eagleman believes that the brain is fast processor in a black box, and all inputs are coded in electrochemical signals^[15]. Human brain can be trained to process complex information and re-establish unusual sensory channels, which may help people with sensory impairments obtain external information through different input channels. For example, deaf people can wear a vest which can translate sound into dynamic patterns of vibration, and after training they can gradually learn the language of the vest and “hear” words^[15]. Similarly, by processing data collected with sensors or signal acquisition devices, a new urban intelligent management system can be formed combined with automatic control technologies of the Internet of Things. Martina Mazzarello et al. introduced the notion of hybrid urban digital integrated systems, aiming at the integration of digital and physical elements in urban environments, to increase the attractiveness of the city to the locals. Shi Jiaying et al. developed a semi-automatic classifier for homogeneous landscape photographs by using Google Cloud Vision API and multi-level hierarchical clustering, which is also a way of mining and reusing existing data.

In this issue, *LA Frontiers* attempts to encourage researchers to explore a more profound understanding of environmental perception based on the development of Cognitive Sciences. The combination of scientific knowledge and technology can contribute to the creation of intelligent built environment that can actively respond to people’s needs. **LAF**

REFERENCES

- [1] American Society of Landscape Architects, Canadian Society of Landscape Architects, Council of Educators in Landscape Architecture, Council of Landscape Architecture Registration Boards, & Landscape Architectural Accreditation Board. (2004). *Landscape Architecture Body of Knowledge Study Report*. Retrieved from https://www.asla.org/uploadedFiles/CMS/Education/Accreditation/LABOK_Report_with_Appendices.pdf
- [2] Fein, A., & Crespi, I. (1977). Landscape Architecture among the Design Professions/A Survey Report. *Journal of Architectural Education*, 31(2), 12-17.
- [3] Yang, R. (2009). Meanings of “Feng Jing.” *Proceeding of the 2009 Chinese Society of Landscape Architecture* (pp. 53-55). Beijing, China: China Architecture & Building Press.
- [4] Liu, B. (2011). Understanding of Five Secondary Disciplines of Landscape Architecture. *Landscape Architecture*, (2), 23-24.
- [5] Kandel, E. R. (2016). *Reductionism in art and brain science: Bridging the two cultures*. New York, NY: Columbia University Press.
- [6] Kahneman, D. (2011). *Thinking, fast and slow* (1st ed.). New York, NY: Farrar, Straus and Giroux.
- [7] Kandel, E. R., Schwartz, J. H., Jessell, T. M., Siegelbaum, S. A., & Hudspeth, A. J. (2013). *Principles of neural science* (5th ed.). New York, NY: McGraw-Hill Medical.
- [8] Kan, I., & Meredith, J. C. (1952). *The critique of judgement*. Oxford, England: Clarendon Press.
- [9] Kaplan, S., & Kaplan, R. (1982). *Cognition and environment: Functioning in an uncertain world*. New York, NY: Praeger.
- [10] Nassauer, J. I. (1995). Messy Ecosystems, Orderly Frames. *Landscape Journal*, 14(2), 161-170. doi:10.3368/lj.14.2.161
- [11] Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective* (1st ed.). Cambridge, England: Cambridge university press.
- [12] Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and motivation I: Defensive and appetitive reactions in picture processing. *Emotion*, 1(3), 276-298. <https://doi.org/10.1037/1528-3542.1.3.276>
- [13] Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology*, 30(3), 261-273. <https://doi.org/10.1111/j.1469-8986.1993.tb03352.x>
- [14] Sarle, W. S. (1994). *Neural networks and statistical models*. Proceedings of the Nineteenth Annual SAS Users Group International Conference, Cary, NC. Retrieved from https://people.orie.cornell.edu/davidr/or474/nn_sas.pdf
- [15] Eagleman, D. (Speaker). (2015). *Can we create new senses for humans* [TED Talk Video]. Available from https://www.ted.com/talks/david_eagleman_can_we_create_new_senses_for_humans